Remarks

The present amendment is submitted in response to the final Official Action mailed on October 3, 2003. Claims 28 and 36-40 were rejected under 35 U.S.C. 102(b) based on Spence et al., U.S. Patent No. 3,167,395 ("Spence"). This ground for rejection is addressed below following a brief discussion of the present invention to provide context.

Claims 1-27, 31-35 and 51-55 were previously cancelled. Claims 28-30 and 36-50 are pending. Applicant acknowledges with appreciation the indication that claims 29, 30 and 41-50 stand as allowed. The application title has been amended to be more clear and distinct.

The Present Invention

One commonly used technique for the control of liquid discharge from a vessel while reducing the need for complex valve systems is a U-valve arrangement. It is advantageous to provide a U-shaped tube, commonly referred to as a U-valve, at a bottom port of a vessel, in order to prevent the self discharge of a liquid from an open bottom port of the vessel. Under ordinary circumstances, the U-shaped tube allows the liquid from the vessel to enter the tube to a level which does not exceed the level of the liquid in the vessel. This arrangement allows the convenient maintenance of an equilibrium of the liquid level in the vessel, without requiring that a valve at the bottom of the vessel remain closed. It is possible, however, to use such a U-shaped tube to discharge liquid from the vessel by applying a negative pressure to the tube. It is also possible to use the U-shaped tube to purge the vessel by gas directed under positive pressure into the vessel from the output end of the U-shaped tube.

A U-valve works reliably with large tubing inner dimensions (IDs), and under room temperature conditions. However, a U-valve based on small ID tubing and operated with

sufficiently hot liquids may cause undesired discharge of the contents of a vessel through the U-shaped tubing. This discharge occurs because of increased pressure inside the vessel and the origination of gas bubbles in the fluid under higher temperature conditions. The formation of gas bubbles can cause the level of liquid in the vessel to rise above the level of liquid in the U-shaped tube, resulting in a siphoning effect, which can cause a complete discharge of the liquid from the vessel. Smaller ID tubing may also exhibit capillary action, which increases the likelihood of siphoning.

A flow-interrupting U-valve apparatus according to one aspect of the present invention comprises a vessel, a U-valve, and a flow-interruption device within the U-valve. The flow-interruption device comprises:

- a sealed chamber;
- an inlet connected to a portion of the U-valve connected to the discharge port of the vessel, the inlet allowing entry of liquid into the chamber, the inlet connected to an inlet tube extending into said chamber; and
- an outlet connected to a section of the U-valve adapted to allow discharge of the liquid, the outlet being separate from the inlet and connected to an outlet tube extending into said chamber in order to interrupt flow of liquid entering the chamber from flow of liquid exiting the chamber.

A liquid flows into the chamber at the inlet until the level of liquid in the chamber reaches the level of liquid in the vessel. Because of the interruption of the liquid flow provided by the sealed chamber of the flow-interruption device, the likelihood of siphoning from the vessel through the U-valve is greatly reduced. It is possible, however, to deliberately evacuate

the vessel by exerting a negative pressure on the U-valve, creating a negative pressure tending to draw liquid out of the chamber through the outlet. The flow-interruption device also allows purging of the reaction vessel, or agitation of liquid within the reaction vessel, by allowing passage of gas into the vessel. An exemplary embodiment of a U-valve apparatus is shown in Fig. 4, as discussed in the specification at page 9, lines 12-27.

The Art Rejection

Claims 28 and 36-40 were rejected under 35 U.S.C. 102(b) based on Spence. This rejection is respectfully traversed in view of the above amendments in claim 28 and the discussion below.

Claim 28 has been amended to be more clear and distinct. Claim 28 now includes the vessel as a separately recited element. The vessel was previously recited in claim 28 in connection with the inlet of the flow-interruption device, and in the preamble. Claim 28 now further recites with regard to the flow-interruption device that the inlet is connected to an inlet tube extending into the sealed chamber, and that the outlet is connected to an outlet tube extending into the sealed chamber. The inlet and outlet tubes are shown in exemplary Fig. 4 and are discussed in the specification, for example at page 9, lines 12-27.

Spence discloses a tubular reactor for imparting, to the liquid contents of the reactor, an oscillatory motion at the frequency for resonance of the system. Fig. 1 shows an embodiment of such a system, in which the reactor pipe or tube T is looped back and forth upon itself to conserve occupancy space of the apparatus. Connected in communication with the reactor pipe or tube are potential energy storing devices shown in the form of gas domes A and B. A gas delivery conduit G is adapted to deliver an inert gas or air to the upper ends of the respective gas

domes A and B. A pulse generating device is provided and is illustratively shown as a driven piston pump P, connected through conduit legs C1 and C2 and gas delivery conduit G, to the gas domes A and B. The pulse generating pump P and conduit legs C1 and C2 are provided with a fluid to be activated by the pump. The liquid, as pulsated or reciprocated in the conduit legs C1 and C2, can rise and fall in the conduit legs within an upper limit of movement which precludes carry over of the liquid into the gas domes A and B. In operation of this system, feed and discharge pumps, which induce progressive flow of the reaction liquid stream through the reactor pipe or tube T, are started. The pulse generating pump P, conduit legs C1 and C2, gas delivery conduit G, and gas domes A and B cause a back and forth cyclic movement of oscillation of the reaction liquid stream in the reactor pipe or tube T along the axis of the stream. Such oscillatory movement of the reaction liquid stream induces vigorous turbulence which facilitates the reaction effects to which the stream is desired to be subjected during its progressive flow through the reactor pipe or tube T. Spence, col. 1, lines 58-61; col. 3, lines 9-11 and 26-73; col. 5, lines 60-63; and col. 5, line 73 through col. 6, line 23.

Spence wholly fails to disclose and fails to suggest inclusion, in either of gas domes A and B, of an inlet connected to an inlet tube extending into such gas domes, or an outlet connected to an outlet tube extending into such gas domes. Therefore, gas domes A and B of Spence are not structurally equivalent to the flow-interruption device recited in claim 28 as now amended. Accordingly, the rejection of claims 28 and 36-40 is not supported by Spence and should now be withdrawn.

Moreover, Applicant respectfully traverses the Official Action's reading of Spence on claim 28. The preamble of claim 28 recites that the flow-interrupting U-valve apparatus is for connection to a discharge port of a vessel, for preventing inadvertent liquid flow from the vessel

through the U-valve. Spence fails to disclose and fails to suggest the use of Spence's systems to address the problem of preventing inadvertent liquid flow from a vessel through a U-valve. Instead, Spence explains that the reactor pipe or tube T shown in Figs. 1 and 2 is looped back and forth upon itself for the purpose of conserving occupancy space of the apparatus. Spence, col. 3, lines 9-11. In operation, a U-valve as discussed in the present specification at pages 1 and 2 for example, prevents the self discharge of a liquid from an open bottom port of a vessel. No such operation is disclosed in Spence, and accordingly the tube T of Spence is not a U-valve. Further, both of Spence's gas domes have the same purpose: facilitating application of pressure into the reactor pipe or tube T as generated by the pulse generating pump P. Spence fails to disclose and fails to suggest the use of gas dome A or gas dome B as a reaction vessel. The Official Action's attempt to construe gas dome A as being a reaction vessel and gas dome B as being a flow-interruption device further necessitates differentiated functions for such domes that are nowhere supported by Spence.

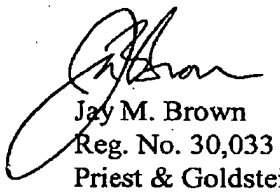
Allowable Subject Matter

Applicant acknowledges with appreciation the allowance of claims 29-30 and 41-50. Concerning the statement of reasons for the indication of allowance of such claims, Applicant provides the following clarifications. Claim 30 recites a "universal fluid exchanger" instead of a "chemical synthesis reaction tool." Claim 30, further to the statement of reasons for allowance, also comprises "an actuator for controlling selectively aligning the injection and evacuation ports and the injection and evacuation fittings, respectively;".

Conclusion

It is believed that all of the pending claims are in order for allowance, in view of the above discussion and the amendments in claim 28. Accordingly, Applicant respectfully requests entry of the subject amendments and allowance of all of the pending claims. The Examiner is invited and requested to please contact the undersigned by telephone to resolve any remaining issues.

Respectfully submitted,



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